

Experience with fetal monitoring in a university teaching hospital

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Summary: Fetal monitoring during labour may be expected to decrease perinatal losses and the number of infants born with brain damage. In a prospective study of intrapartum fetal monitoring in selected high-risk pregnancies in a Winnipeg hospital the monitoring rate was 26.5% and the cesarean section rate in the monitored group was 22.0%. The fetal outcome in the monitored group was better than in the unmonitored group. The establishment of a fetal intensive care unit is believed to be strongly desirable in improving fetal surveillance during labour. Fetal monitors should be stationed in the delivery room as well as in the first-stage room.

Résumé: On peut espérer que la surveillance du fœtus pendant le travail pourra diminuer la mortalité périnatale et également le nombre de nouveau-nés qui sont porteurs d'une lésion cérébrale. Dans une étude prospective de la surveillance fœtale intrapartum de cas sélectionnés de grossesse à risque élevé, effectuée dans un hôpital de Winnipeg, la proportion de cas surveillés était de 26.5% et la proportion de césariennes dans le groupe surveillé, de 22%. Le sort ultime des fœtus a été meilleur dans le groupe surveillé que dans le groupe non surveillé. Nous estimons que l'établissement d'une section de soins intensifs des fœtus est éminemment souhaitable, cette section ayant pour but d'améliorer la surveillance fœtale pendant le travail. Les

surveillants affectés à cette section devraient être disponibles dans la salle d'accouchement aussi bien que dans la salle prévue pour le premier stade du travail.

The woman about to become a mother, or with her newborn infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden or stretches her aching limbs... God forbid that any member of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly, or selfishly!

— Oliver Wendell Holmes

Of 17 994 babies born in Manitoba in 1972, 227 were stillborn and 224 died within 28 days of birth; the perinatal mortality for 1972 was therefore 25.1/1000 total births. The Québec Perinatal Committee^{1,2} has stated that 8.5/1000 total births is the irreducible perinatal mortality due to lethal malformations and unpredictable deaths, and with this figure one may estimate that, for Manitoba in 1972, 298 perinatal losses were potentially avoidable.

Mortality statistics are relatively easy to gather; morbidity data are less readily available but are of equal if not greater importance. If one accepts the dictum "for every death there is a damage", then it is a reasonable estimate that, in Manitoba, 451 other infants born in 1972 have brain damage that will prevent them from ever reaching their full intellectual potential. The expenditure for complete custodial care of a brain-damaged child for life is estimated to be \$500 000. Assuming an average lifespan of 50 years, the yearly cost would be \$10 000 for one individual and \$4.51 million for the 451. And it has been estimated that in

Canada as a whole there currently are 44 000 individuals with cerebral palsy, 262 000 mental defectives and 43 000 epileptics.³

In the hope of decreasing perinatal losses, particularly those due to asphyxia, and also decreasing the number of children born with brain damage, increasing use is being made of intrapartum fetal monitoring. The traditional monitoring method in the evaluation of the intrauterine environment and fetal status is auscultation of the fetal heart, but, as clinically practised, this has proved an unreliable indicator of fetal distress. However, more sophisticated fetal monitoring systems are no longer restricted to the research laboratory and these can provide early warning of fetal distress during labour.

Thus, electronic fetal heart rate monitoring, though not yet a routine obstetric practice, is being used in some centres for surveillance of fetal status in labour in selected high-risk pregnancies. Decision can be made in favour of the fetus that could not be made by means of conventional methods. In particular, through evaluation of the relationship between the fetal heart rate and uterine contractions, reliable predictive information about the fetus may be obtained.

This paper is a report of a prospective study of local experiences with intrapartum electronic fetal heart rate monitoring that was conducted during a 5-month period, July 1 to Nov. 30, 1973. Results of fetal outcome during labour in this period (when intrapartum fetal monitoring was used in selected high-risk pregnancies) were also compared with those during a similar 5-month period in 1971 (when there was no intrapartum fetal monitoring for high-risk pregnancies).

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Materials and methods

St. Boniface General Hospital is a teaching hospital affiliated with the University of Manitoba. Approximately 3000 babies are delivered there each year. The present intrapartum fetal monitoring program for selected high-risk pregnancies was introduced to the obstetric service in the fall of 1972.

Three Hewlett Packard fetal monitors are in use. Each has five components: phonocardiograph, ultrasound transducer and electrocardiograph (for measuring fetal heart rate), and tokodynamometer and pressure transducer (for measuring the expulsive force of uterine contractions). Thus, for external monitoring the phonocardiograph or ultrasound transducer, and tokodynamometer may be used; for internal monitoring the electrocardiograph and the pressure transducer may be used. Depending on the specific clinical situation combinations of the above methods may be used. An example of a normal monitor tracing of the fetal heart rate is shown in Fig. 1.

Results

During the study period there were 1080 deliveries; fetal monitoring was done in 286 high-risk cases, giving a monitoring rate of 26.5%. The indications were frequently multiple and are listed in Table I.

Mothers' age and parity

Of the monitored patients 271 (94.8%) were within the 16- to 35-years age group, 3 (1.0%) were less than 16, and 12 (4.2%) were more than 35. Of the 286, 154 (53.8%) were primigravidas; 13% (4.5) had had five or more pregnancies that reached the period of viability.

Mode of delivery

Spontaneous vaginal delivery occurred in 121 (42.3%) of the monitored patients. Cesarean sections were performed in 63 (22.0%). Other modes of delivery were low forceps in 44 (15.4%), mid forceps in 38 (13.3%), Kielland forceps in 19 (6.6%) and vacuum extraction in 1 (0.3%).

Condition of newborn monitored infants

Birth weight was less than 2500 g in 16 (5.6%) and more than 4000 g in 17 (5.9%) of the newborn infants. There were 138 males and 148 females. Apgar score at 1 minute was 7 to 10 in 247 (86.5%) of the infants, 4 to 6 in 33 (11.5%) and 1 to 3 in 4 (1.4%). One infant was stillborn owing to asphyxia and was delivered by emergency cesarean section after some de-

lay. There was also one neonatal death due to irreversible hypoxic brain damage caused in part by delay in delivery of the fetus.

Fetal heart rate patterns

As Table II shows, periodic acceleration was the most common pattern. By itself it was harmless and the fetuses were generally born with good Apgar scores. Early deceleration was also common and benign. This pattern occurred more often after rupture of membranes and towards the end of the first stage of labour.

Variable deceleration was a feature of approximately half of the tracings. This pattern was usually corrected by maternal postural adjustments. If it was transitory good Apgar scores were usually recorded. One fetus had persistent variable deceleration, then pronounced bradycardia, and died on the 25th day after emergency cesarean section. Presentation had been footling breech and the membranes had ruptured at 34 weeks' gestation. Oxytocin (Syntocinon) augmentation was instituted. Fetal monitoring, initially by external and then by internal methods, was established only after the fetal heart rate irregularity had been detected by auscultation. There was also some delay in performing the emergency cesarean section.

Late deceleration, if not unduly prolonged, was associated commonly with good Apgar scores. There was one stillbirth associated with persistent late deceleration followed by pronounced bradycardia. This was in a postmature fetus for whom the fetal monitor was used when the fetal heart rate abnormality was detected by clinical auscultation. The external monitor was used initially and the pronounced fetal bradycardia was mistaken

to be the maternal pulse. Fetal bradycardia was subsequently confirmed by the internal monitor. All this resulted in considerable delay in delivery.

In the 286 patients in this study 473 fetal heart rate patterns were observed. Different patterns were commonly seen in the same patient during labour.

Complications

Wound infections developed in three patients after cesarean section and pelvic infections in three. Spiral electrodes and intrauterine pressure catheters had been used in these latter patients, but it is difficult to attribute these complications directly to internal monitoring.

Only one case of scalp hematoma was found in this series of infants. The baby was admitted to hospital 32 days after delivery for incision and drainage of a scalp abscess. A spiral electrode had been applied during labour.

Table I—Indications for intrapartum fetal monitoring

Indication	No. of patients (and % of total monitored)
Oxytocin induction or augmentation	116 (40.6)
Epidural anesthesia	94 (32.9)
Hypertension of pregnancy	56 (19.6)
Prolonged pregnancy (>42 wk)	53 (18.5)
Prolonged labour (>24 h)	41 (14.3)
Meconium passage	34 (11.9)
Fetal heart rate irregularity on auscultation	19 (6.6)
Breech presentation	15 (5.2)
Antepartum hemorrhage	11 (3.8)
Prematurity	7 (2.4)
Diabetes mellitus	5 (1.7)
Rhesus isoimmunization	4 (1.4)
Previous stillbirth or neonatal death	2 (0.7)
Intrauterine growth retardation	2 (0.7)
Anemia	1 (0.3)
Previous uterine scar	1 (0.3)
Miscellaneous	8 (2.8)

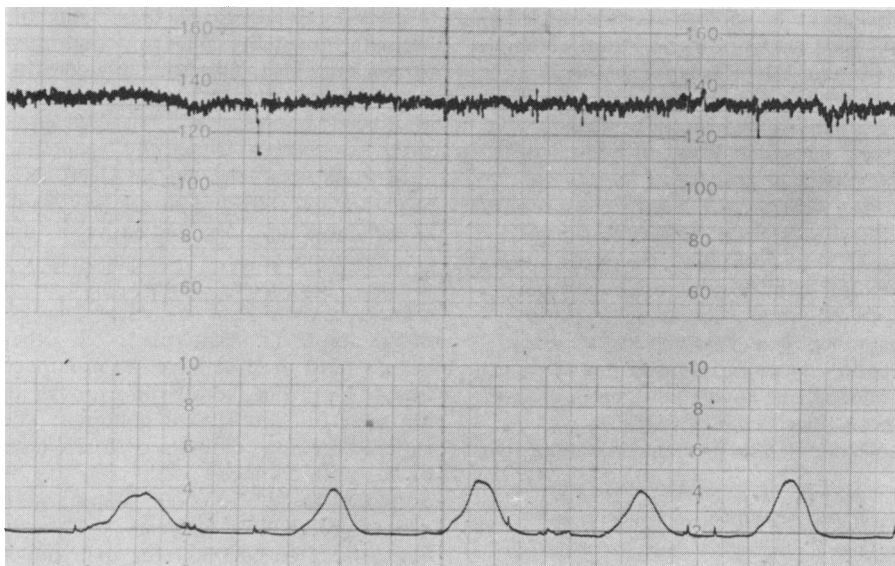


FIG. 1—Normal intra-amniotic pressure tracing and fetal heart rate pattern (as recorded by internal monitoring).

Comparison with 1971 data

Findings for the two periods, July 1 to Nov. 30, 1971 and July 1 to Nov. 30, 1973, are compared in Table III.

Monitoring method: Of the 286 patients monitored in 1973, 37.8% were monitored by the external method (tokodynamometer and ultrasound transducer), 11.2% by the internal method (spiral electrode and intrauterine pressure catheter) and 51.0% by mixed

methods.

Mode of delivery: In 1973 there was a large decrease (about 20%) in the number of vaginal deliveries. The cesarean section rate was doubled and the cesarean section rate for fetal distress quadrupled.

Apgar score: The Apgar scores did not differ noticeably in the two study periods.

Perinatal mortality: Excluding intrauterine deaths occurring before the

onset of labour the crude perinatal mortality per 1000 total births over the 5-month period was 17 in 1971 and 19 in 1973. The corrected perinatal mortality (excluding infants weighing less than 1000 g) was 9 in 1971 and 13 in 1973, corresponding to 7.8 and 12.2/1000 total births, respectively.

The slight increase in the corrected perinatal mortality in 1973 may be attributed in part to this hospital's recently assumed importance as a major referral centre for high-risk pregnancies in Manitoba. However, if the corrected perinatal mortality figures for 1973 are analysed further (Table IV), the value of intrapartum fetal monitoring will be appreciated. In the unmonitored group the corrected perinatal mortality per 1000 total births was 13.9, whereas in the monitored group it was only 7.0 despite the fact that the women with high-risk pregnancies were concentrated in the monitored group. The two perinatal deaths in the monitored group, as noted previously, were due to avoidable factors including delay in delivery.

The causes of the perinatal deaths during the two study periods are listed in Table V.

Discussion

This study, albeit a small one, brought out many points of practical importance.

Proper surveillance of the fetus during labour depends on adequate staffing and instruction of nurses, clinical clerks, interns, residents and obstetricians in the techniques of fetal monitoring and interpretation of fetal heart rate patterns. The establishment of a fetal monitoring team, to include consultants with adequate experience in fetal monitoring, would improve fetal surveillance during labour. Also, the establishment of a perinatal resuscita-

Table II—Fetal heart rate patterns

Patterns	No. of infants with Apgar scores of				Total no. of patterns (n = 473)
	0	1 to 3	4 to 6	7 to 10	
Normal (no baseline or periodic changes)			1	18	19
Moderate bradycardia (100 to 120 beats/min)			5	16	21
Pronounced bradycardia (100 beats/min)	1	1		3	5
Moderate tachycardia (160 to 180 beats/min)		1	4	17	22
Pronounced tachycardia (180 beats/min)			1		1
Loss of beat-to-beat variability		1		2	3
Periodic acceleration		4	13	128	145
Early deceleration		1	11	90	102
Late deceleration	1			21	22
				(95.5%)	
Variable deceleration		5	15	113	133
				(85.0%)	

Table III—Comparison of data, 1971 and 1973

Findings	Period	
	July 1 to Nov. 30, 1971	July 1 to Nov. 30, 1973
Deliveries, no.	1161	1080
Patients monitored, no. (and %)	0 (0)	286 (26.5)
Method of monitoring, %		
External	0	37.8
Internal	0	11.2
Mixed	0	51.0
Mode of delivery, no. of patients (and %)		
Spontaneous	740 (63.7)	597 (55.3)
Forceps	320 (27.6)	336 (31.1)
Vacuum extraction	27 (2.3)	12 (1.1)
Cesarean section	74 (6.4)	135 (12.5)
For fetal distress		
Among all patients	9 (0.8)	34 (3.1)
Among monitored group	0 (0)	29 (10.1)
Apgar score, no. of patients		
7 to 10	1075	976
4 to 6	56	60
1 to 3	21	27
Perinatal mortality		
Crude: Stillbirths, no.	4	10
Neonatal deaths, no.	13	9
Total	17	19
Corrected: Stillbirths, no.	4	8
Neonatal deaths, no.	5	5
Total	9	13
Per 1000 total births	7.8	12.0

Table IV—Corrected perinatal mortality, July 1 to Nov. 30, 1973

Category of death	Perinatal mortality			
	Among unmonitored fetuses (n = 794)		Among monitored fetuses (n = 286)	
	No.	Per 1000 total births	No.	Per 1000 total births
Stillbirths	7	8.8	1	3.5
Neonatal deaths	4	5.0	1	3.5
Total	11	13.9	2	7.0

Table V—Causes of perinatal death*

Cause of death	Period	
	July 1 to Nov. 30, 1971	July 1 to Nov. 30, 1973
Stillbirth		
Unexplained	1	2
Congenital anomalies	—	3
Abruptio placentae	2	—
Syphilis	1	—
Asphyxia	—	1
Cord prolapse	—	1
Fetal ascites	—	1
Neonatal death		
Prematurity	2	1
Congenital anomalies	2	1
Pulmonary hemorrhage	1	—
Traumatic delivery	—	1
Asphyxia	—	1
Infection	—	1

*Excluding deaths of infants weighing less than 1000 g and deaths occurring before the onset of labour.

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 ...tick...tick...**Otrivin**...tick...tick
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 long-lasting relief of
 nasal
 congestion

OTRIVIN® works and continues working
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 providing up to 12 hours of gentle relief
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Recommend **OTRIVIN**...available in nasal
 solution and spray for both children and adults.

Indications Nasal congestion in colds, rhinitis, sinusitis; also, for the tension headache, tubal block and serous otitis media associated with nasal congestion. Otrivin facilitates examinations and is a useful pre- and postoperative adjunct.
Dosage May be used 2 or 3 times daily, more often if required. Adults and children over 12: one or two 0.1% sprays, or two or three 0.1% drops, into each nostril. Children 6 to 12: one or two 0.05% sprays, or two or three 0.05% drops, into each nostril. Children under 6: one 0.05% spray or one 0.05% drop, each nostril.

Side effects Rarely, rebound congestion, mild tingling. Headache, drowsiness, palpitations or lightheadedness have been reported. **Caution** Overdosage in young children may produce profound sedation. **Supplied** All forms contain xylometazoline hydrochloride. Nasal Solution, 0.1%; bottles of 1 fl. oz. with dropper. Nasal Spray, 0.1%; plastic squeeze bottles of 20 ml. Pediatric Nasal Solution, 0.05%; bottles of 1 fl. oz. with dropper. Pediatric Nasal Spray, 0.05%; plastic squeeze bottles of 20 ml.

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tion team comprising an anesthetist, an obstetrician and a neonatologist residing in the hospital 24 hours a day and available within minutes is highly desirable in order to avoid any delay during delivery. Moreover, fetal monitoring systems should not be confined to the rooms of patients in the first stage of labour but should also be in the delivery room and in the cesarean section room.

Proponents of electronic fetal monitoring claim a decreased rate of performance of cesarean section for fetal distress. Our study demonstrated an increase. Careful scrutiny suggested that this was probably due to two factors:

1. Improvement in detection of fetal distress by continuous fetal monitoring during labour. This is desirable because it distinguishes insidious traumatic fetal neurologic damage from that due to the insults of labour.
2. Lack of understanding of fetal heart rate patterns. A small number of cesarean sections were done unjustifiably because of obstetrician distress rather than fetal distress. This was commonly seen in cases of variable deceleration patterns and little attempt was made to alleviate cord compression by maternal postural adjustments.

The internal method of monitoring is more reliable than the external method. Attempts should be made to correct fetal distress by conservative measures for a short period before emergency cesarean section is undertaken. If improvement in ominous fetal heart rate patterns is not observed within 30 minutes of institution of corrective measures, the baby should be delivered as expeditiously and safely as possible.

Intrapartum fetal surveillance may be further improved by introducing fetal blood sampling. This will help to identify the fetus who has acidosis and hypoxia in addition to a disturbed fetal heart rate pattern.

Electronic fetal heart rate monitoring for the diagnosis of fetal distress does not replace clinical judgement or concern and compassion for the patient. Rather, it improves clinical perspective by permitting better surveillance of the fetus.

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